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GB 1461918
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US 3449213A
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# (54) Improvements relating to incineration of biological material

(57) In the cremation of human or animal remains conventional heat sources such as gas, oil of electricity are replaced or supplemented by microwave heating. Microwave pre-treatment may be followed by conventional heating. The pre-treatment may be accomplished in the primary combustion chamber of a cremator adapted for microwave pre-heating. Alternatively, the microwave heating means may be provided in an ante-chamber for pre-heating the coffin prior to entry into the main combustion chamber. Pathological waste e.g. sewage screens may be incinerated with the aid of microwav heating.

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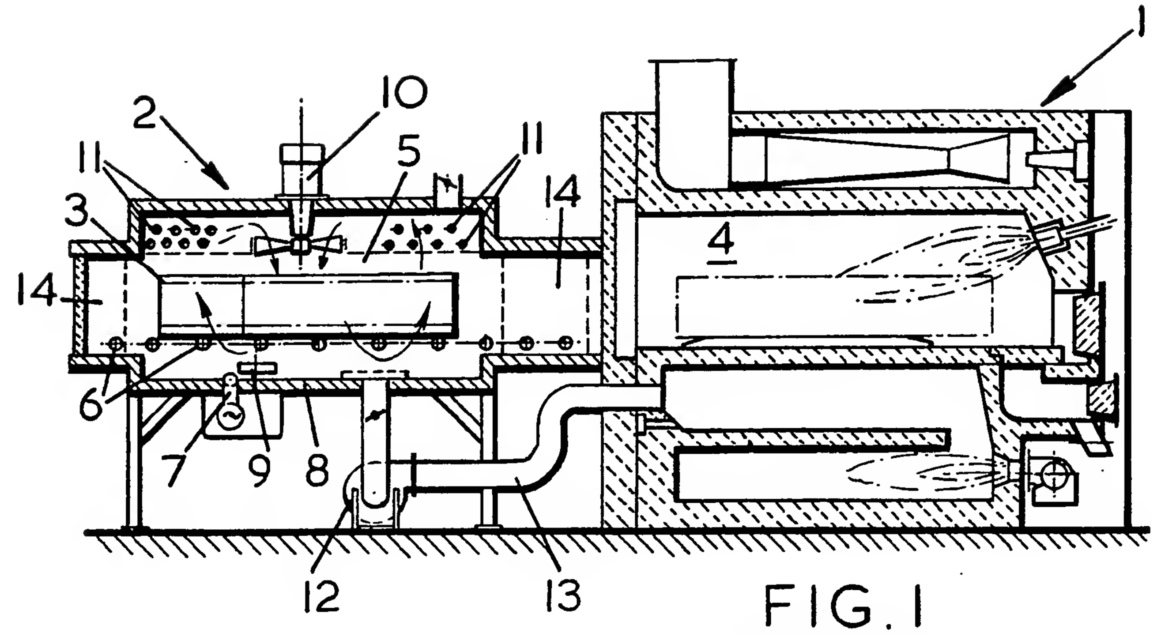


FIG. 1

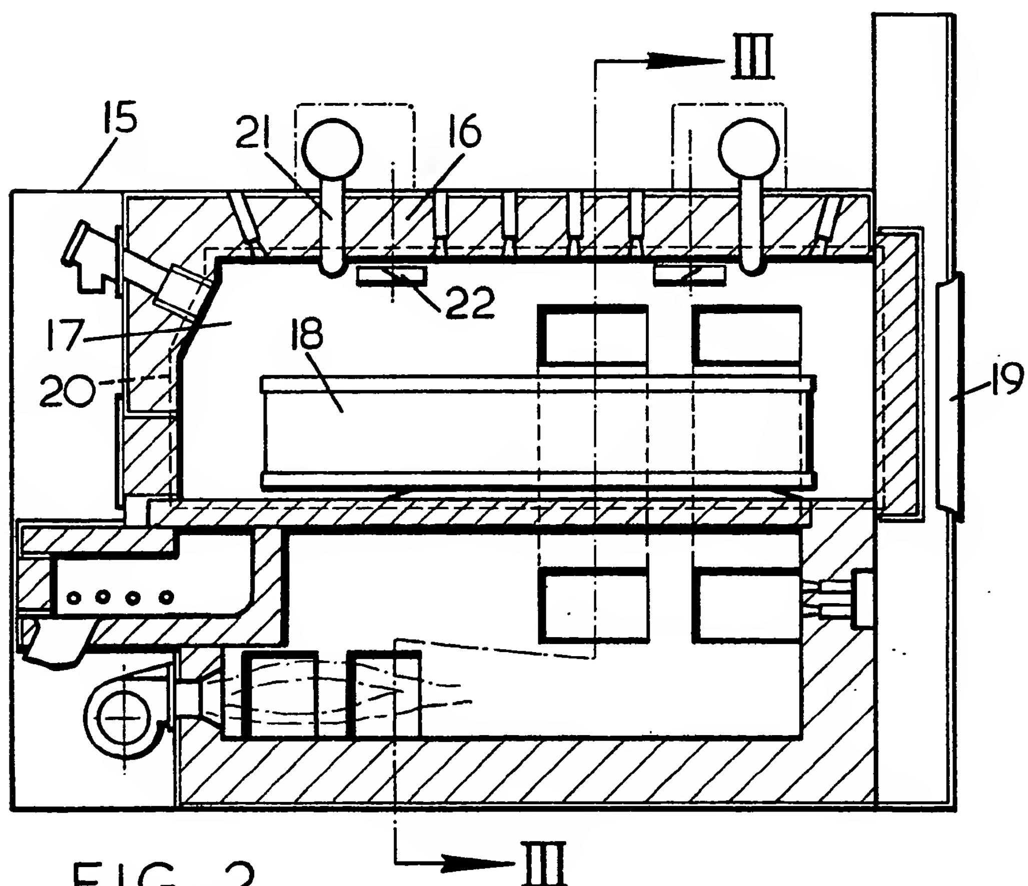


FIG. 2

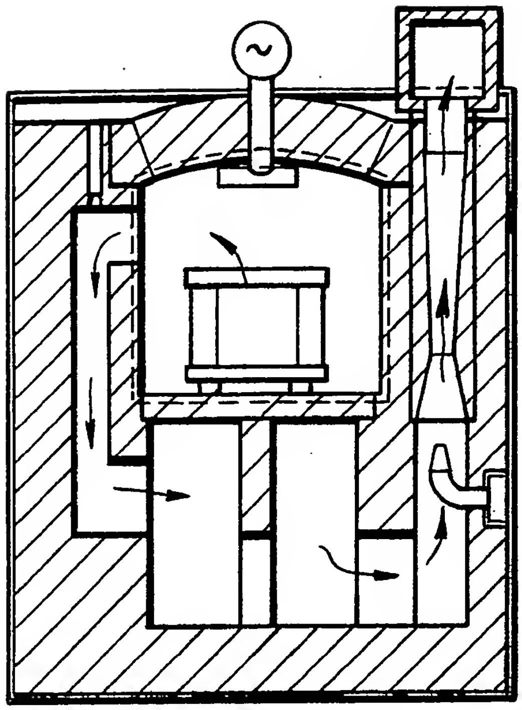

FIG. 3

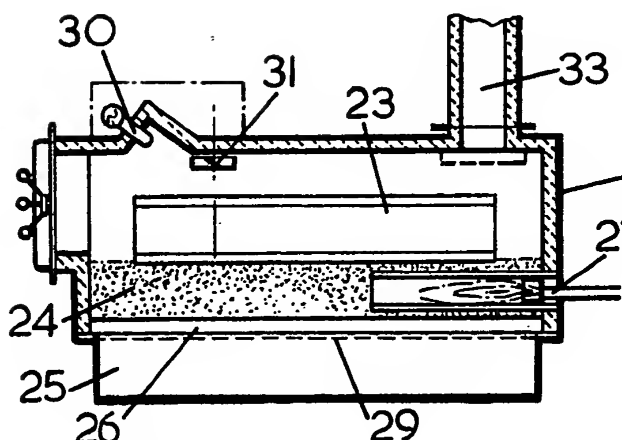


FIG. 4

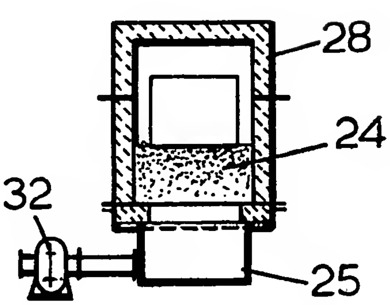


FIG. 5

SPECIFICATION

**Improvements relating to incinerati n of biological material**

This invention relates to the incineration of biological material and particularly, but not exclusively, to the cremation of human or animal remains.

Conventional cremators for the cremation of human bodies in coffins may vary considerably in their structural design but the heating means are invariably gas burners, oil burners or electrical heating elements. Provided that sufficient oxygen for combustion of the body and coffin is also present, the cremation process is normally completed in about 1 to $1\frac{1}{4}$ hours.

Using such conventional heating techniques the heat for initiating and maintaining combustion is applied to the body externally and the outer layers of the body must be burnt before successively deeper layers can be exposed and consumed. A significant factor inhibiting the rate of combustion is the water content of the body. In the average person about 50 to 70% of the body weight is attributable to water, variations within this range being caused by such factors as differences in fat content between the sexes. This moisture has to be driven off before the ignition temperature can be reached. The migration of water from within the body to the combustion interface is significantly retarded by shrinkage of the fleshy cellular structure and degradation of the protein in the external body surface which is subjected to the highest temperature because it is located at the combustion interface. The rate of moisture migration and consequent evaporation is thus subject to natural regulation. Retention of liquid water within the body prevents the temperature of the body material from exceeding the wet bulb temperature of the body material until an appreciable amount of evaporation has occurred and the body is relatively dry. The average cremation time is thus increased and the cremator throughput reduced.

Similar problems may occur with the incineration of other biological material.

It is an object of the present invention to obviate or mitigate the aforesaid disadvantages.

According to the present invention there is provided a method of and apparatuis for cremating human or animal remains wherein conventional heating means of the kind mentioned above are replaced or supplemented by microwave heating means.

The term "microwave heating" is used herein to mean heating by means of radio waves in the frequency range from about 1000 megahertz upwards and the term "microwaves" is to be construed accordingly. In practice frequencies are assigned by the authorities for industrial, scientific and m dical us s. Th present assigned fr quencies ar 896 and 2,450 megahertz with a spread of $\pm$ 50 megahertz in each case. The definition used herein is intended to include the specified values of the assigned frequencies and any substitute or additional frequencies that the authorities may designate.

Microwave heating techniques are of course well established and the mechanism of heating is well understood. An article entitled "Basic Principles of Microwaves and Recent Developments" by Samuel A. Goldblith in "Advances in Food Research" Vol. 15 published in 1966 describes the mechanism as follows:

"All matter is made up of electrically charged particles, both positive and negative. In normal, undistributed matter, there are equal numbers of positively and negatively charged particles. Thus, most materials are electrically neutral.

"If the material is non-conducting, i.e. a dielectric, and is placed in an electromagnetic field, the charged asymmetric molecules, of which the dielectric (such as a foodstuff) is composed, are driven first one way and then another. Each of the asymmetric molecules attempts to align itself with the rapidly changing alternating-current field. In this field, the molecules act as miniature dipoles, and, while oscillating around their axes in an attempt to go to the proper positive and negative poles, intermolecular friction is created and is manifested as a heating effect. At the microwave frequencies, e.g. 915 megacycles, the molecules oscillate back and forth 915 million times per second ........

"Some materials exhibit this intermolecular motion more than others. These are said to be "lossy". The degree of "lossiness" of a material varies irregularly with frequency, temperature, and the nature of the material. The greater the "lossiness" of a material, the greater the absorption of the microwave energy and the greater the production of heat."

The same article describes different types of microwave process devices including batch and continuous ovens. The microwave radiation is usually emitted from a power tube or magnetron into a cavity with reflective walls which reflect the microwaves repeatedly throughout the cavity for uniform absorption by the material to be heated. A waveguide may also be used to distribute the energy as required for example in a continuous process in which the material is to be subjected to microwave irradiation in successive stages.

The primary application of microwave heating is in the defrosting and cooking of foodstuffs. In the article referred to above Goldblith discusses the possible uses of radio-frequency (RF) energy in food processing under the heads: improvement of storage quality of cottonseed, destruction of foot and mouth disease virus, dehydration of vegetables, destruction of insects in grain, production of mould free bread, blanching of foods, defrosting of frozen foods, microwaves in freeze-drying, microwave cooking, microwaves for st riiization, use of RF energy for baking, and us of RF nergy for processing potato chips.

Although it is clear from the literature that microwave heating has a wide range of applications there is no suggestion that complete incineration of biological tissue may advantageously be effected

or assisted by microwave h ating and, in particular, there is no indication that the cremation of human remains would benefit from such a technique.

Although there has not yet been sufficient opportunity to elaborate full practical details of the invention it is likely that a preferred embodiment of the invention will involve microwave pretreatment in a cremator also provided with conventional heating means. It is of course conceivable that the microwave pretreatment stage takes place in a pretreated chamber and, while such an arrangement has the advantage that the pretreatment chamber may be better adapted for microwave heating, considerable problems arise because of the necessity of transferring the coffin and contents from the pretreatment chamber into the conventional combustion chamber. Where microwave pretreatment occurs within the primary combustion chamber the cremator is preferably a conventional cremator adapted for microwave preheating. However, the cremator may itself be of novel design but suited to the requirements of microwave and conventional heating.

It may, however, transpire that it is equally or more effective to commence or continue the microwave heating during the conventional combustion phase and in principle the invention contemplates complete incineration by microwave heating only, although this is likely to prove impractical because of the high power requirement.

The invention will now be further described by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a diagramatic side elevation sectional view of a first embodiment of apparatus according to the invention;

Fig. 2 is a corresponding view of a second embodiment;

Fig. 3 is a section on line III—III in Fig. 2;

Fig. 4 is a diagramatic side elevation sectional view of a third embodiment, and

Fig. 5 is a cross section of the apparatus of Fig. 4.

In the first embodiment shown in Fig. 1 a conventionally heated cremator 1 of the kind described in U.K. Patent No. 748489 of North Eastern Gas Board is associated with a dessicator 2 in which a coffin 3 is subjected to a microwave pretreatment before being advanced into the primary combustion chamber 4 of the cremator 1. The dessicator 2 has a cavity 5 with rollers or skids 6 for supporting the coffin 3 in a central position suitable for absorption of microwaves generated by an emitt r 7 mounted at a suitabl location in a wall 8 of the enclosure and associated with a rotary reflective device 9 for distributing the radiation. The walls of the dessicator are made of stainless steel or other suitable material to assist reflection and containment of the microwaves. In addition the dessicator has a circulating fan 10, conventional heating means 11 ( .g. electrical heating elements) for keeping evaporated moisture in the vapour phase (say about 150°C), and an exhaust fan 12 with ducting 13 for transferring the water vapour into a higher temperature part of the adjacent cremator 1. End vestibules 14 are provided to prevent stray microwave emission and means (not shown) are provided for transferring the coffin into the cremator on completion of the microwave pretreatment.

In the second embodiment illustrated in Figs. 2 and 3 microwave dessication and conventional combustion are carried out as two stages of the cremation process in a cremator of the same general kind illustrated in Fig. 1. The cremator has an outer steel casing 15 with a refractory lining 16 defining a primary combustion chamber 17 into which a coffin 18 is placed through a charging door 19 in the usual way. Although it is theoretically possible to use the steel casing or shell of the cremator as the microwave enclosure (which will entail use of an appropriate steel e.g. stainless steel) this may be wasteful of energy and may not meet the strict safety requirements applicable to installations employing microwaves. Accordingly, provision is made for the microwave "cavity" to be more precisely defined by a screening 20 provided just below the hot face of the refractory material bounding the primary combustion chamber should this be found necessary. Such screening may take the form of a metal mesh, metalised refractories or other metallic means of retaining the microwaves within the enclosure so defined. It will be appreciated that metallic continuity of the screening must be maintained through any movable doors, sliding tiles etc. Such continuity may be registered or proved by electrical means, e.g. by measuring circuit continuity or resistance.

In modifying the cremator for microwave operation care is also taken to screen all exits and entrances to and from the cremator, whether from the microwave cavity or not and the outer metal shell 15 of the cremator is designed and fabricated so as to ensure safety in operation.

A microwave emitter 21 and rotary reflective device 22 are shown mounted in the ceiling of the primary combustion chamber 17 though it is appreciated that other locations and the use of wave guides may prove more practical.

In the third embodiment illustrated in Figs. 4 and 5 a coffin 23 is supported during cremation on a fluidised bed 24 separated from an underlying pressure chamber 25 by a floor 26 made of diffusion tiles. The conventional heat source is provided by a semi-immersion burner 27 and additional burners may be provided in the space above th bed. This emb diment of cr mator has an outer metal casing 28 defining the top and side walls of the microwave cavity th floor of which is provided by a metal mesh 29 directly beneath the diffusion tiles. A microwave emitter 30 and rotary reflector 31 are mounted in the top of the microwave cavity, though it is appreciated that other locations and the use of wave guides may prov mor practical.

A blower 32 is provided for blowing fluidising air to the bed 24 *via* the pressure chamber 25 and a duct 33 with a screened opening directs the combustion products to an after-burner chamber (not shown).

It will be appreciated that numerous modifications may be made without departing from the scope of the invention. The embodiments that have been described are batch operation cremators for the cremation of human (or animal) remains. Similar principles apply to the incineration of biological material generally and it is within the contemplation of the invention to apply microwave heating to the incineration of such materials in the same way *(mutatis mutandis)* as has been discussed above in relation to cremation. Thus biological and pathological waste, for example sewage screenings, might benefit from being incinerated with the aid of microwave heating. Such incineration would more readily be effected by a continuous operation than cremation which is necessarily a batch operation.

In the embodiments described above the conventional heat source is gas but it will be appreciated that other heating means may be used, e.g. oil burners or electrical heating elements.

CLAIMS

1. A method of incinerating biological material, comprising replacing or supplementing gas, oil or electrical heating means by microwave heating means.

2. A method as claimed in claim 1, wherein human or animal remains are cremated with the aid of microwave heating means.

3. A method as claimed in claim 2, wherein microwave pretreatment is followed by gas, oil or electrical heating.

4. A method as claimed in claim 3, wherein the microwave pretreatment is accomplished in the primary combustion chamber of a cremator adapted for microwave preheating.

5. A cremator comprising a main combustion chamber, support means for supporting the coffin in the combustion chamber and microwave heating means for heating the combustion chamber.

6. A cremator as claimed in claim 5, further comprising gas, oil or electrical heating means for heating the combustion chamber.

7. A cremator as claimed in claim 6, wherein the microwave heating means is provided in an ante-chamber for preheating the coffin prior to entry into the main combustion chamber.

8. A method of incinerating biological material substantially as herein described with reference to Fig. 1 or Figs. 2 and 3 or Figs. 4 and 5 of the accompanying drawings.

9. A cremator substantially as herein described with reference to and as illustrated in Fig. 1 or Figs. 2 and 3 or Figs. 4 and 5 of the accompanying drawings.

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